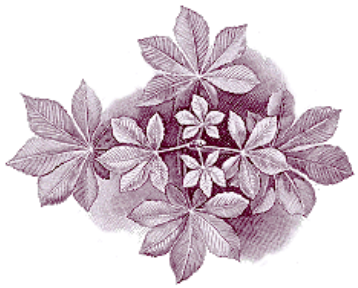
Logs of Straws: Dendrochronology



Background

Trees are some of nature's most accurate timekeepers. Their growth layers, appearing as rings in the cross section of the tree trunk, record evidence of floods, droughts, insect attacks, lightning strikes, and even earthquakes.

Tree growth depends on local conditions, which include the availability of water. Because the water cycle, or hydrologic cycle, is uneven—that is, the amount of water in the environment varies from year to year—scientists use tree-ring patterns to reconstruct regional patterns of drought and climatic change. This field of study, known as dendrochronology, was begun in the early 1900's by an American astronomer named Andrew Ellicott Douglass.

While working at an observatory in his native Arizona, Douglass began to collect pine trunk cross sections to study their annual growth rings. He thought there might be a connection between sunspot activity and drought. Such a connection could be established, he believed, through natural records of vegetation growth.

Douglass was not the first to notice that some growth rings in trees are thicker than others. In the climate where Douglass was working, the varying widths clearly resulted from varying amounts of rainfall. In drier growing seasons narrow rings were formed, and in growing seasons in which water was more plentiful, wide rings occurred.

In addition to correlating the narrow rings to periods of drought and, in turn, to sunspot records, Douglass had to establish the actual year each tree ring represented. Because absolute ages can be determined through dendrochronology, the science has since proven useful far beyond the narrow study to which Douglass applied it.

Computer analysis and other methods developed since Douglass' time have allowed scientists to better understand certain large-scale climatic changes that have occurred in past centuries. Likewise, highly localized analyses are possible. Archaeologists use tree rings to date timber from log cabins and Native American pueblos by matching the rings from the cut timbers of homes to rings in very old trees nearby. Matching these patterns can show the year when a tree was cut and, thus, reveal the age of a dwelling.

To determine whether changes now occurring in climate are part of the Earth's normal pattern or are induced by human activity, scientists rely on the history of climatic changes both locally and globally as revealed by tree rings, ice cores, pollen samples, and the fossil record. Computers are used to detect possible patterns and cycles from these many sources. In dendrochronology, large data bases allow scientists to compare the ring records of many trees and to construct maps of former regional climates. The evidence collected so far suggests that climatic change is simply a part of life on Earth. The extent to which human activity affects the way the global climate is changing now is not yet fully understood.

USGS

Global Change

Time and Cycles

Activity (Allow 45-60 minutes)

In this activity straws will be used to simulate tree-ring core samples. Using the straws, students will work in groups to reconstruct a 50-year climatic history. Students will record this chronology on a 3-meter time line designed to highlight significant social, personal, and scientific events covering the same period.

Dendrochronologists seldom cut down a tree to analyze its rings. Instead, core samples are extracted using a borer that is screwed into the tree and pulled out, bringing with it a straw-size sample of wood about 4 millimeters in diameter. The hole in the tree is then sealed to prevent disease.

Materials

For each group of four students:

! One set of white straws marked with ring patterns (see illustration below). Markings can be produced with permanent black marker on paper or plastic straws.

! One 3-meter strip of adding machine tape for each group

! Colored pencils for each group

! Colored markers for each group

! A notebook for recording results (optional)

! Reference material such as almanacs that provide students with the dates of social and scientific events over the last 4 decades.

Prior to the activity the teacher should construct sets of straws similar to the set shown in the illustrations.

Group students in teams of four. The following information on the straw samples can be recorded on the blackboard or copied and handed out. Review with the students some of the tips on reading tree rings found in the boxed section.

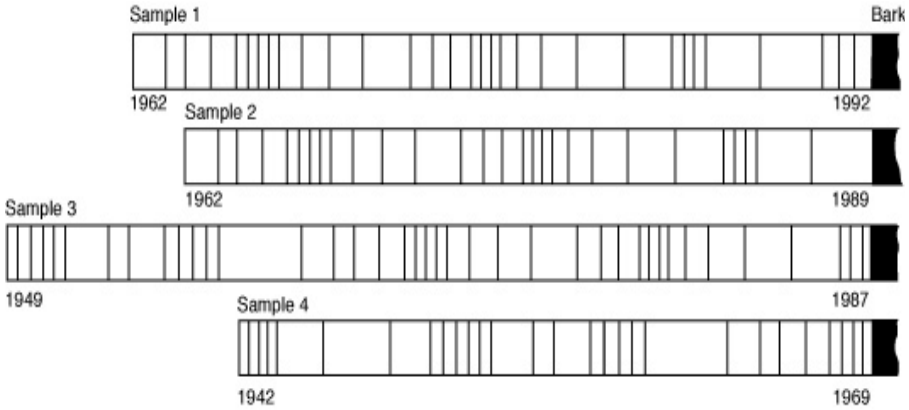
Reading Tree Rings

Core sample 1 is to be used as a standard against which to compare the others, because a bore date of 1992 has been established. Notice the varying patterns of ring widths in sample 1; look for similar patterns in other samples.

Core sample patterns are alternating dark and light lines. The darker lines of a core sample represent the end of a growing season The light-toned space between the two darker lines represents one growing season.

Tree rings are formed from the center of the tree outward. The ring closest to the bark is the youngest and final growth ring. The ring closest to the center of the tree is the oldest growth ring. Neither the outer layer of bark nor the central pith layer of a sample is counted when determining the age of a sample.

Similar ring patterns are found between trees growing under the same conditions. The most obvious feature of these patterns is varying widths. Widening of a ring indicates good growing conditions, while narrowing indicates poor ones. Conditions can include climatic factors such as temperature and moisture as well as factors such as erosion, fire, landslides, etc.



Procedure

Imagine you have core samples from four trees:

Sample 1. From a living tree, July 1992, Pinetown Forest.

Sample 2. From a tree from the Pinetown Christmas Tree Farm.

Sample 3. From a log found near the main trail in Pinetown Forest.

Sample 4. From a barn beam removed from Pinetown Hollow.

1. Determine the age of each tree (how many years it had been growing) by counting the rings. Record your answers in your notebook or in the first column on the chart below:

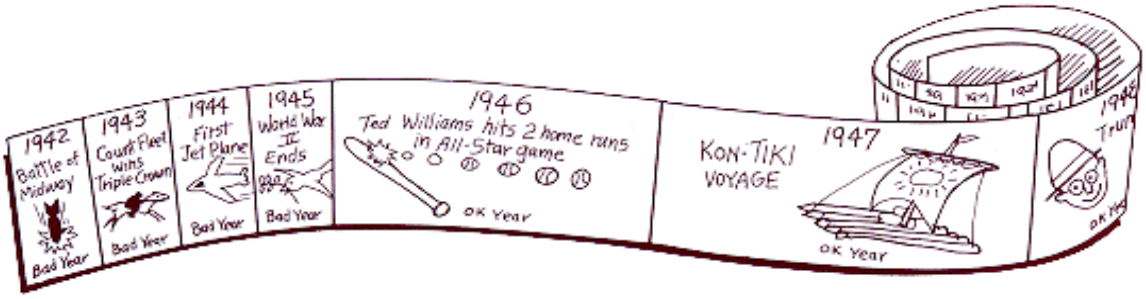
	Age of tree	Year tree was cut	Year growth began
Sample 1			
Sample 2			
Sample 3			
Sample 4			

2. Look for patterns in the rings. Patterns in this exercise match well, but actual ring patterns will vary among different species of trees. Once a ring pattern has been discovered, line up all the samples. Because you know that Sample 1 was cut in 1992, you can match the patterns of all the other samples and determine when all the other trees were cut or cored and also when they began to grow. Record this information in your notebook or fill in the chart above.

3. Make a time line. Spread out the adding machine tape. Beginning at the left end of the tape, record each year from the earliest year identified on the tree-ring samples through 1992. After the years are recorded on the strip, identify years that were good growing years for the trees in Pinetown, and years that were poor. Think of other events that might have happened during this time period such as your birthday, Presidential elections, important scientific discoveries, or record-setting sports achievements. Fill them in on the time line. You can color the time line and illustrate it with drawings, photographs, or newspaper clippings.

Questions

Which ring on each tree represents your birth year? What kind of growing season existed that year in Pinetown? In which years did droughts occur in Pinetown? Is there a pattern to the droughts?
What buildings in your areas were built during the lifetime of these trees?



Extensions

Measure the tree rings in the photograph on the back of the poster. Assume the tree was cut in 1992. How old is the tree? Can you determine good and bad years for growth?

Find and map the locations of some of the oldest known trees in your neighborhood. Sketch what you think a core from one of these trees might look like.

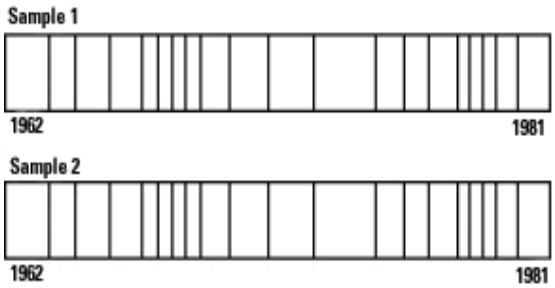
Contact your local forestry service or science museum and obtain some actual cross sections of trees that have been cut in your area. Use the techniques applied during this activity to "read the tree." If a tree has been cut in your neighborhood recently, look at the tree rings on the stump or ask if you can keep a small piece of the trunk.

Create some simulated core straws of your own for another group to analyze and report about.

For the Teacher

Aligning the samples

The following illustration shows how samples 1 and 2 can be aligned. Have the students align all four samples so that the patterns match, and determine the years when each tree was cut and when it began to grow. Have them count all the rings from the oldest samples as they are aligned with the younger samples to determine the total amount of time represented by the rings. Count aligned rings that appear on several samples only once.



Charts

The charts should be completed as follows:

	Age of tree	Year tree was cut	Year growth began
1	31	1992	1962
2	28	1989	1962
3	39	1987	1962
4	28	1969	1942

The total time covered by the tree rings is 50 years, from 1942 to 1992.

Answers to questions

The answers to some of the questions in the activities will depend on the individual class—for example, when they were born or when buildings in their area were built. In looking at the climate record as revealed in the tree rings, notice that there is a significant period of poor growing conditions in each of the four decades covered by the tree samples. This pattern, which can be graphed, is the type of pattern scientists might look for when studying climate change.

Classroom Resources

Angier, Natalie, Warming?—Tree rings say not yet: New York Times, Tuesday, December 1, 1992, p. C-1, C-4.

U.S. Geological Survey, 1991, Tree rings—timekeepers of the past: Reston, Virginia, USGS, 15 p.